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OSCILLATOR WITH STABILIZED FEEDBACK

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Fig. 1

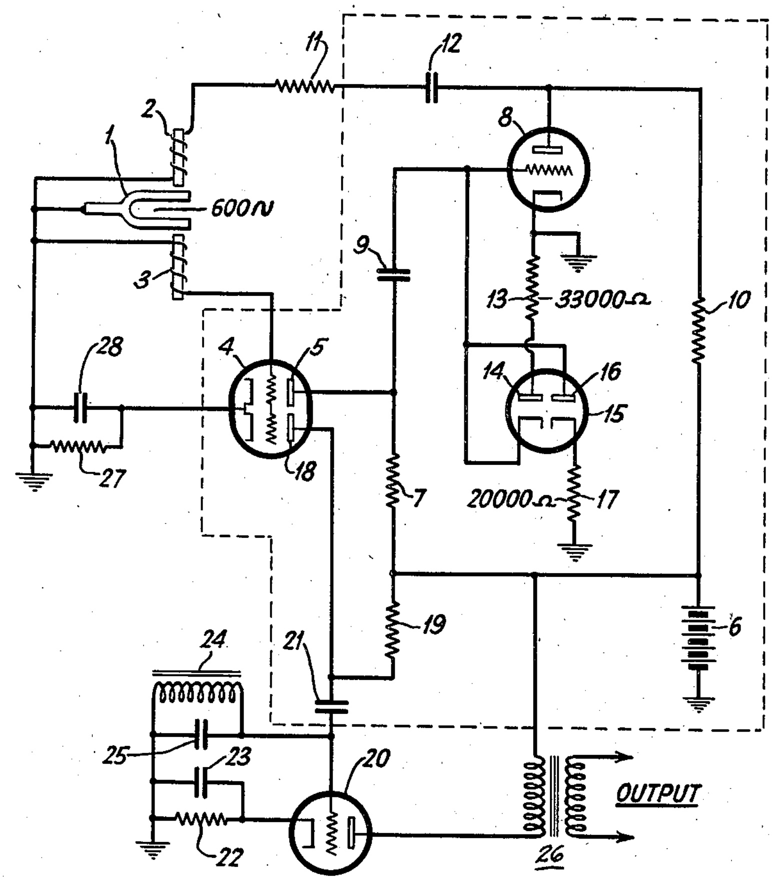
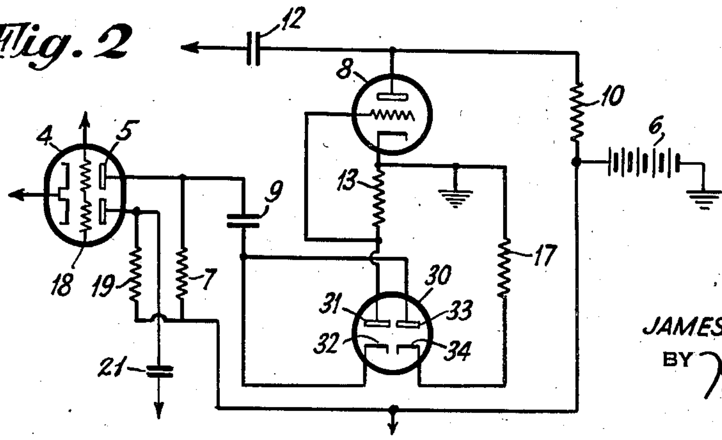


Fig. 2



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2,300,271

OSCILLATOR WITH STABILIZED FEEDBACK

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Application September 5, 1940, Serial No. 355,437

4 Claims. (Cl. 250—36)

This invention relates to oscillation generating systems, and particularly to a mechanically controlled oscillation generating system.

A primary object of the present invention is to provide a source of oscillations of constant frequency and constant amplitude.

Another object is to provide such a source which is particularly adaptable for use in the audio frequency range below ten thousand cycles.

A further object is to provide a system for generating oscillations of constant frequency and constant amplitude which is compact and substantially unaffected by temperature changes.

A further object is to provide a low frequency electrical source of constant frequency and constant amplitude of output which may be operated from the standard power supply systems regardless of the usual fluctuations in voltage encountered in such a system.

A still further object is to provide a low frequency oscillation generator with means for rectifying the components of the output energy and for dividing this energy into positive and negative components, the energy of said positive components being dissipated in a resistor and the negative components applied to the grid of a limiter tube thereby maintaining a grid potential on said limiter tube variable between cathode potential and a more negative potential, said limiter tube being used for supplying feed-back energy to the frequency-determining means by which the oscillation generator proper is controlled.

In general, the foregoing objects are achieved by the provision of a tuning fork having a driving magnet and a pick-up magnet, the driving magnet being coupled to the output circuit of a limiter tube, while the pick-up magnet is caused to feed control potentials to the grids of a twin triode amplifier tube. One section of this twin triode is used to supply feed-back energy to the limiter tube, while the other section of the twin triode is used to amplify the oscillations generated and to supply the amplified oscillations to a succeeding stage of amplification, the output circuit of which is coupled to any desired utilization device. In circuit with the grid of the limiter tube I preferably employ a double diode tube for rectification purposes. This tube has the function of dividing the wave derived from one section of the twin triode amplifier into its positive and negative components, the negative component of said wave being subsequently applied to the grid of the limiter tube, while the positive component is dissipated in a suitable resistor. It is found in practice that the stability of the system is greatly increased by providing a constant fork driving power as is accomplished with the aid of the aforesaid double diode rectifier tube. The range of amplitude in the power delivered to the load resistor 7 may be made as wide as the ratio of 9 to 1 without seriously disturbing the stability of the system.

The improvements in low frequency oscillation generators as herein set forth may be compared with earlier forms of such oscillators, typical of which is that disclosed in my Patent No. 2,144,236, granted January 17, 1939. In the system which I disclosed in that patent the grid of a limiter tube was driven positive and the limiting action on the positive half cycles was obtained by plate current saturation. Since the point of saturation is dependent to a large extent upon the filament emission, a variation in driving power was liable to occur as a result of changes in the cathode heater potential.

In the present system the heretofore encountered difficulties have been overcome by the use of a high mu tube as a limiter device, and the grid potential of this tube is caused to vary from zero to a negative value. A component of the positive half cycles of the generator is caused to pass through one-half of the twin diode rectifier and through a suitable load resistor to ground so as to utilize the charge on a coupling condenser across which energy is fed back to the driving coil for the tuning fork.

The plate current of the high mu limiter tube is quite low even with zero bias on its grid. Saturation, therefore, is never reached, as the emission from the cathode may be considerably in excess of that required for the small plate current permitted by a high resistance in the plate circuit of the limiter tube.

My invention is illustrated in more detail in the accompanying drawing, wherein

Figure 1 shows a circuit diagram of one embodiment of the invention, and

Fig. 2 shows a modification of a portion of the circuit arrangement shown in Fig. 1.

Referring to Fig. 1, I show a tuning fork 1 having a driving coil 2 and a pick-up coil 3. Merely by way of illustration the tuning fork is indicated as though designed for vibration at a frequency of 600 cycles per second. The pick-up coil 3 has one end grounded and the other end leads to the two grids of a twin triode tube 4. Amplification takes place in this tube in such manner that the outputs from both sections are in phase. The two cathodes of the tube 4 are interconnected and are grounded through a cathode resistor 27. In shunt with this resistor is a suitable capacitor 28.

The output circuit which includes the anode 5 is fed with direct current potential from any suitable source 6, this circuit including a resistor 7 for the purpose of resistance coupling to the grid of a limiter tube 8 across coupling condenser 9. The output circuit of the limiter tube 8 may also be supplied with anode potential from the source 6 fed through the resistor 10. This resistor, by way of illustration, may have a value of the order of 200,000 ohms.

The driving coil 2 for the tuning fork is grounded at one end and is connected through a resistor 11 and a coupling condenser 12 to the output circuit of the limiter tube 8.

The cathode of the limiter tube 8 is grounded and is also connected through a resistor 13 to one anode 14 of the twin diode tube 15. The other anode 16 of this tube is connected to the grid of the limiter tube 8, and also to the cathode opposite the anode 14 in the tube 15. The remaining cathode of this twin diode 15 is connected through a resistor 17 to ground. With the circuit connections as shown, and due to the fact that resistors 13 and 17 are of substantially different values, the grid of the limiter tube 8 is prevented from being driven more positive than the potential of its cathode. Its bias is, therefore, varied only between zero and some suitable negative value. The effect of this arrangement is to cause the limiter tube 8 to deliver a substantially square wave for energizing the magnet 2 whereby the tuning fork is driven.

The twin triode tube 4, as heretofore mentioned, includes a section which is useful for amplification of the energy which is applied to a further stage of amplification and then coupled to a utilization circuit. In this portion of the twin triode tube 4 is an anode 18. Direct current is supplied to this anode across resistor 19. This circuit is resistance-coupled to the grid of an amplifier tube 20. coupling condenser 21 being provided. The cathode of the amplifier tube 20 is connected to ground through a cathode-resistor 22. This resistor is preferably in shunt with a capacitor 23. The biasing circuit for the tube 20 includes preferably an inductive impedance 24 in shunt with a condenser 25. The inductance 24 and capacitance 25 form a tank circuit which may be tuned to the frequency of the oscillations generated.

The output circuit of the tube 20 includes the primary of a transformer 26. The secondary of this transformer may be connected to any suitable utilization device.

Referring now to Fig. 2 I show a modification of the circuit arrangement of Fig. 1. The double diode discharge tube 30 of Fig. 2 is substituted for a similar tube 15 in Fig. 1. A portion of the circuit arrangement of Fig. 1 which is included in a dotted line enclosure may be bodily replaced by the circuit arrangement shown in Fig. 2. The details of Fig. 2 will now be described.

The output circuit which is connected to the anode 5 in the tube 4 is coupled by means of the capacitor 9 to the cathode 32 and also to the anode 33 in the tube 30. The anode 31 in this tube is connected directly to the control grid in the tube 8 and is also connected through a cathode resistor 13 to the grounded cathode of the tube 8. The positive wave peaks impressed across the coupling capacitor 9 are dissipated by rectification in the space path between electrodes 33 and 34, this path being completed to ground through the resistor 17. The negative wave peaks produce a space current between the electrodes 31 and 32 such that the grid of the tube 8 becomes negatively biased. Variations in this bias are, therefore, dependent upon the amplitude of the negative wave peaks and consequently the limiter tube 8 will operate in dependence upon the control as given by these rectified negative impulses, thereby delivering a suitable value of feed-back energy across the capacitor 12 for exciting the driving coil 2 which is in association with the tuning fork.

It will be observed from the showing in the drawing as well as from the above description that the grid of the limiter tube 8 receives no potential at all or a negative potential, which bias is, therefore, varied only between zero and some suitably negative value.

Those skilled in the art will appreciate that whether my invention is carried out by one or the other of the two alternative embodiments as shown and described the objects and advantages of the invention will be attained. It will also be understood that other modifications may be made without departing from the spirit of the invention. This invention itself is therefore to be regarded as though limited only in accordance with the claims.

I claim:

1. In a mechanical vibrator of the type which generates low frequency electrical oscillations, an amplifier for said oscillations, a second stage amplifier for a utilizable output component from the first said amplifier, a feed-back circuit effective to sustain oscillations in said vibrator, said feed-back circuit including a discharge tube having a cathode, a control grid and an anode, means coupled to said anode for exciting said vibrator, a capacitor for feeding control potentials from the first said amplifier to the control grid of said discharge tube, and means connected in circuit between said cathode and said control grid for maintaining a bias on said grid which varies only between zero and a negative value with respect to the cathode, the last said means comprising a double diode rectifier tube, said rectifier tube having a cathode and a non-opposing anode connected to the control grid of the discharge tube in said feed-back circuit, the remaining electrodes being connected through independent parallel-disposed resistors to the cathode of the discharge tube in said feed-back circuit, said resistors being unequal in value.

2. A constant frequency, constant amplitude oscillation generator having a feed-back circuit, a discharge tube the space path of which is included in said feed-back circuit, said tube having an input circuit connected between its cathode and its control grid, and being controlled by a potential applied thereto from said generator, said input circuit including a full-wave rectifier of the four-terminal type having two of its oppositely poled terminals for respectively different unilaterally conductive paths connected to said control grid, and the remaining terminals connected respectively to resistors of unequal value, and means for maintaining the terminals of said resistors remote from said rectifier at the potential of said cathode, thereby to prevent the bias applied to the control grid of said tube from becoming positive with respect to its cathode.

3. An oscillation generator having a load circuit and a feed-back circuit, said feed-back cir-

cuit including an electromagnetic exciter means for said generator and including an electron discharge tube amplifier the cathode-anode circuit of which is coupled to said exciter means, a control grid for the tube of said amplifier, a double diode tube having the cathode of one of its space paths and the anode of the other of its space paths both connected to said control grid, a resistive connection of predetermined value in circuit between ground and the anode of the first said space path in said double diode tube, a resistive connection of lesser than said predetermined value in circuit between ground and the cathode of the second said space path in said double diode tube, and a ground connection to the cathode of said amplifier tube, the combination so defined being such that the control grid of said amplifier tube is prevented from being driven positive with respect to its cathode.

4. An oscillation generator having a mechanical vibrator, electro-magnetic means for exciting said vibrator, electro-magnetic means for deriving output potentials from said vibrator, electronic means having two output circuits for amplifying said potentials, a utilization device coupled to one of said output circuits, a feed-back circuit coupled to the other of said output circuits, an amplifier in said feed-back circuit, said amplifier having a grounded cathode and being arranged to feed a pulsating current to said exciting means, and means including a full wave rectifier having its unidirectional paths oppositely faced toward ground connections of unequal impedance, the junctions between two terminals of said unidirectional paths being connected to said amplifier grid, for causing the grid of said amplifier to be controlled by potentials which vary only between a zero value and a negative value with respect to the cathode of said amplifier.

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